

Atmosphere Resource Recovery & Environmental Monitoring for Long Duration Exploration Project (ARREM)

Completed Technology Project (2011 - 2014)



Project Introduction

The AES Atmosphere Resource Recovery & Environmental Monitoring (ARREM) for Long Duration Exploration Project project is maturing Atmosphere Revitalization Systems (ARS) and Environmental Monitoring (EM) systems that will reduce risk, lower lifecycle cost, and validate operational process design and system architectural concepts for future human exploration missions. The project is maturing these technologies using the ISS state-of-the-art hardware as a point of departure. This project merged into the AES Life Support Systems Project in FY15.

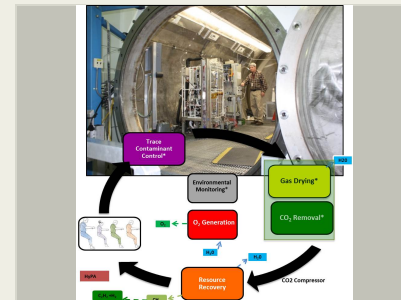
The project focuses on key physico-chemical process technologies for Atmosphere Revitalization Systems (ARS) that increase reliability, capability, and consumable mass recovery as well as reduce requirements for power, volume, heat rejection, and crew involvement. For the Environmental Monitoring (EM) systems effort, the project is developing and demonstrating onboard analysis capabilities that will replace the need to return air and water samples to earth for ground analysis. This effort is addressing these challenges by adopting a new architecture that is based on the modular integration of multiple sensing modalities, employing a hybrid combination of simple, rugged technologies and, where needed, highly capable complex approaches, to completely address monitoring needs of the future. It incorporates Microelectromechanical Systems (MEMS) technologies to enable significant miniaturization over current systems, and selects elements offering both low resources and high reliability operation for affordability. The project is developing, demonstrating and/or testing leading process technology candidates and system architectures that will meet or exceed current requirements and fill capability gaps or significantly improve the efficiency, safety, and reliability over the state-of-the-art (SOA). The project's main goal is to demonstrate test articles (at various technology readiness levels) in a ground test facility under relevant flight conditions.

Anticipated Benefits

The project is advancing the technical maturity of candidate technologies for a flexible Atmosphere Revitalization Systems (ARS) and Environmental Monitoring (EM) systems architectures spanning the range of exploration mission objectives and vehicle concepts, thus providing risk reduction and developmental economy to flight project development programs.

Anticipated benefits include:

- Technologies could be used to help reduce CO₂ levels in the environment
- Monitoring of harmful chemical contamination in air and water
- Improved air purification systems in closed environments



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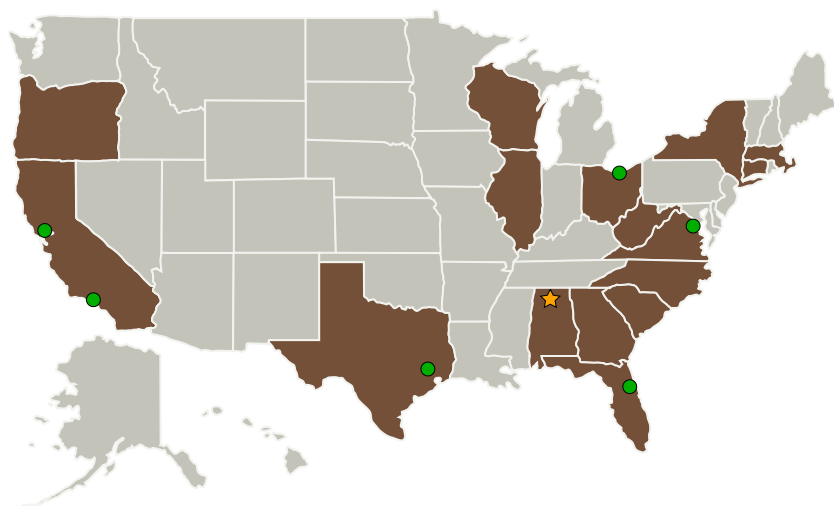
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Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

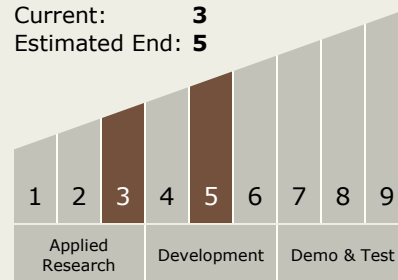
Christopher L Moore

Project Managers:

Monserate C Roman
David F Howard

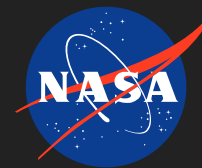
Technology Maturity (TRL)

Start: 3
Current: 3
Estimated End: 5



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Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Aerfil, LLC	Supporting Organization	Industry Small Disadvantaged Business (SDB)	New York
Al Razaq Computing Services	Supporting Organization	Industry Small Disadvantaged Business (SDB)	
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Cbana Laboratories	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Champaign, Illinois
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama
Dynamac Corp.	Supporting Organization	Industry	
ECLS Technologies	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	
Georgia Institute of Technology-Main Campus(GA Tech)	Supporting Organization	Academia	Atlanta, Georgia

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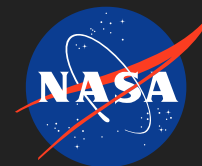
Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.1 Infrastructure Optimization
 - └ TX13.1.3 Commodity Recovery

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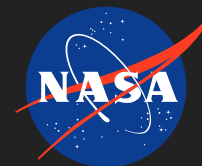


Organizations Performing Work	Role	Type	Location
Giner Electrochemical Systems, LLC	Supporting Organization	Industry	Newton, Massachusetts
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Honeywell International	Supporting Organization	Industry	
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
JSC Engineering, Technical, and Science(JETS)	Supporting Organization	Industry	Texas
● Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
Millennium Engineering and Integration Company	Supporting Organization	Industry	Arlington, Virginia
MTS MIPSS (Engineering Center Support Contract)	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Alabama
● NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
Orbital Technologies Corporation	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Madison, Wisconsin
Port City Instruments, LLC	Supporting Organization	Industry	North Carolina

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Precision Combustion, Inc.	Supporting Organization	Industry	North Haven, Connecticut
QinetiQ North America(QNA)	Supporting Organization	Industry	
Teledyne Brown Engineering	Supporting Organization	Industry	
Thorleaf Research, Inc.	Supporting Organization	Industry	Santa Barbara, California
UMPQUA Research Company	Supporting Organization	Industry	Myrtle Creek, Oregon
University of California-Berkeley(Berkeley)	Supporting Organization	Academia	Berkeley, California
University of California-San Diego(UCSD)	Supporting Organization	Academia	La Jolla, California
University of South Carolina-Columbia	Supporting Organization	Academia	Columbia, South Carolina
Wyle Laboratories, Inc.	Supporting Organization	Industry	

Co-Funding Partners	Type	Location
National Energy Technology Laboratory(NETL)	R&D Center	Albany, Oregon
Navy	US Government	

Primary U.S. Work Locations	
Alabama	California
Connecticut	District of Columbia

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Primary U.S. Work Locations (*cont.*)

Florida	Georgia
Illinois	Massachusetts
New York	North Carolina
Ohio	Oregon
Puerto Rico	South Carolina
Texas	Virginia
West Virginia	Wisconsin

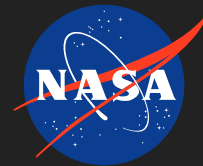
Project Transitions

 **October 2011:** Project Start **September 2014:** Closed out

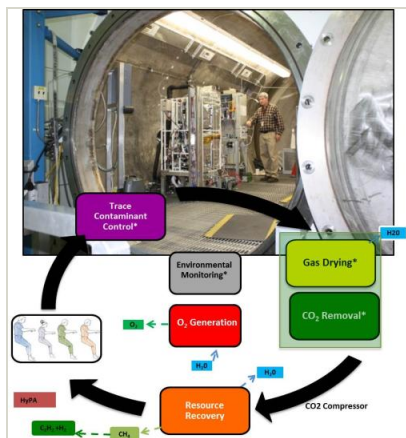
Closeout Summary: To request closeout information for this project, please send an email with the Subject "TechPort Closeout Report Request" to hq-aes@mail.nasa.gov and specify which project closeout report you are requesting.

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Images



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(<https://techport.nasa.gov/image/2736>)